THURSDAY, MAY 1, 1919.

THE COMPLETE PHYSICAL CHEMIST.

A System of Physical Chemistry. By Prof. W. C. McC. Lewis. (Text-books of Physical Chemistry.) Second edition. In three volumes. Vol. i., "Kinetic Theory." Pp. xii+494. Price 15*s.* net. Vol. ii., "Thermodynamics." Pp. vi+403. Price 15*s.* net. Vol. iii., "Quantum Theory." Pp. viii+209. Price 7*s.* 6*d.* net. (London: Longmans, Green, and Co., 1918–19.)

A REVIEW of the first edition of Prof. Lewis's book appeared in these columns in September, 1916, and the fact that a second edition has been called for so soon must be very gratifying to the author. Prof. Lewis has taken advantage of the opportunity thus presented him of introducing a few corrections and amendments, and has considerably increased the subject-matter. The principal changes include the insertion of a section on X-rays and crystal structure, large additions to the sections on colloids, catalysis, etc., a new chapter on osmotic pressure, and the expansion of the last chapter of the original vol. ii. into a separate vol. iii., dealing exclusively with the quantum theory. The excisions are remarkably few, and we have only noted one of any importance.

The author's method of treatment of his subject-matter naturally remains unaltered. The more classical portions are presented to the student in much the same manner as in several of the older text-books (and, it might be added, lecture courses). As regards more recent work the author is apparently well aware of his rather obvious lack of the critical faculty, and in the presentation does not emphasise any particular point of view as being his own. This he achieves by giving the results of each piece of work in, so far as possible, "the investigator's actual words." But, whatever we may think of the lack of criticism in the presentation of any particular summary, we must confess that, as a whole, the work included in the survey of each section is usually admirable in its selection. So broad is the field covered by the author that we can scarcely expect a critical and authoritative pronouncement on every separate item.

Considering more closely a few points in vol. i., we should have thought, since the work of Bohr and Moseley has now been embraced in the author's survey (in vol. iii.), that there would be some alterations in the first chapter. The author's sense of values appears at fault when he once again apportions more space to Nicholson's theory of the atom than to the whole subject of radioactivity. There are some parts of the subject, such as those dealing with the nuclear charge and isotopism, the omission of which seems particularly regrettable. As it stands, this small section has scarcely been brought up to the knowledge of the year 1916, far less of 1918, and this is true of other references to the subject, such as that on p. 449, which also seems in urgent need of revision. In the summary of the Braggs' work presented in the second chapter we were struck by the consistent use of the sequence (y, x, z) instead of the customary (x, y, z) in the naming of intercepts, and by the referring to the sodium chloride space lattice as face-centred, while what is meant is face-centred relative to one kind of atom. In chap iii. we once again encounter "the more convenient logarithmic form $\Sigma\nu \log C = K$" instead of the usual $\log K$. On p. 197 the last column in the first table is still uncorrected. Prof. Lewis apparently now regards methyl-orange as "essentially a basic indicator," and in consequence inserts as a correction the word *basic* on p. 256, with the result that we are informed that, since methyl-orange is neutral-coloured in a 10^{-4} $\mathrm{H}^{\cdot}$ solution, "its (basic) dissociation constant lies in the neighbourhood of 10^{-4}." This should evidently be 10^{-10}. On p. 440 the author introduces as a new term "the *displacement* effect." In view of the use that has already been made of the defining word in Wien's *displacement law*, the term is not too happily chosen, and "*replacement* effect" is perhaps as suitable a descriptive term.

Turning to vol. ii., we find that a great portion consists in the presentation, with the aid of thermodynamics, of matter which has already been partly discussed in vol. i. Whether this separation is altogether desirable is an arguable point. To select an example at random, we confess we are unable to see the virtue in giving in vol. i. a table of the temperature variation of a mass action constant, while the theory of the variation is given in vol. ii. Again, in the new chap. viii., "the *mechanism* of osmotic pressure" might have seemed more in place in the first volume, which deals with the kinetic point of view. As it is, of course, it fits in quite well. In the addition at the end of chap. i., in speaking of the vapour pressure in a column, the author remarks: "the pressure at the top being *entirely* due to the kinetic bombardment by the molecules." But surely it could be argued that the pressure at the foot is also *entirely* due to the kinetic bombardment by the molecules, even if it is greater than the pressure at the top by the weight of the column per unit area. We note that the author has now adopted "S" in place of "ϕ" as the symbol for entropy. In his brief reference to the entropy equation of a perfect gas there is no adequate discussion of C_v, and the evasion of the lower limits of the integral is not too adroit. A symbol, by the way, is omitted in the first equation on p. 46. The footnote on p. 100 to the effect that "thermodynamic reversibility has, of course, nothing to do with reversibility in the chemical or mass action sense" seems open to question. On p. 140 the author is evidently unable or unwilling to decide against Planck, though Planck has undoubtedly slipped. As regards the footnote on p. 142, there is a laboratory method of measuring e.m.f. which does *not* involve the use of a potentiometer.

©1919 Nature Publishing Group

The third volume presents in an easily accessible form the most important theoretical and practical work on the quantum hypothesis, embracing much that is not included in Jeans's report. We have noted one awkward slip, a "howler" on p. 27 in the proof that the central force is equal to mv^2/ρ. The angle between tangent and secant is made equal to the angle *at the centre*, and then by an abuse of infinitesimal geometry the correct answer is obtained. In chap. v., on the structure of the atom, we are surprised to find Moseley's work dismissed in less than a page, the same space nevertheless being allocated to Allen's empirical relation, while Barkla is not mentioned. There is a misprint in the second formula on p. 115. We sincerely deprecate the habit of bestowing double-barrelled names on equations save when there is clear evidence of independent discovery. From the text-book it would appear that the "Marcelin-Rice" equation (p. 139) was discovered by Marcelin, and the method of deduction improved by Rice. If this is the case the second name should be dropped from the equation. We should have liked to see the appendices (of which i. and ii. are by J. Rice) incorporated in the text.

We have confined our attention almost entirely to the additions and alterations made by the author in his new edition. If we have emphasised the defects rather than the excellences of his work, we must plead that we are seeking to help him in the presentation of the only complete system of physical chemistry by an English-speaking author. We have no hesitation in saying that we regard these volumes as absolutely indispensable books of reference to every advanced worker in physical chemistry and chemical physics, though it is unfortunate from the point of view of a standard text-book that the author's treatment of the newer portions of his subject will compel him to make frequent changes in subsequent editions. A. M. W.

ACIDOSIS.

The Principles of Acidosis and Clinical Methods for its Study. By A. Watson Sellards. Pp. vi+117. (Cambridge, Mass.: Harvard University Press, 1917.) Price 4*s.* net.

ACIDOSIS may be defined as a condition in which there is a diminution in the normal slight alkalinity of the blood or tissues of a living organism; and a real or supposed state of acidosis has come in recent times to play a leading part in the explanation of many abnormal symptoms, including in particular a number of those which have been produced in the course of the war. The whole subject is thus one of considerable present scientific interest, and for this reason Dr. Sellards's book on the principles of acidosis is specially welcome.

The fact that in the living body the faintly alkaline reaction of the blood and tissues is regulated in a remarkable manner has been known for long. The non-volatile acid or alkali produced within, or introduced into, the body varies considerably, according to the composition of the food; and in man acid predominates, mainly on account of the fact that the alkali contained in the food is not sufficient to neutralise the sulphuric and phosphoric acids produced in the oxidation of proteins. The excess of inorganic acid is partly got rid of by the secretion of an acid urine, and partly neutralised by the formation of ammonia; while organic acids introduced into or formed within the body are for the most part oxidised along with other organic materials, the resulting carbonic acid being got rid of in respiration. It is only in recent years, however, that it has been shown that the concentration of free carbonic acid in the blood is regulated by the breathing with extreme delicacy, and that the breathing is itself normally regulated by the very minute changes in hydrogen-ion concentration produced by variations in the concentration of free carbonic acid in the blood, or by variations in its hydrogen-ion concentration from other causes.

The lungs thus constitute a safety valve which acts more freely or less freely according as the hydrogen-ion concentration of the blood increases or diminishes. We can correlate the variation in respiratory activity, first, with the variations in concentration of CO_2 in the air of the lung alveoli, and consequently of the free carbonic acid in the arterial blood; secondly, with the corresponding variations in hydrogen-ion concentration of the arterial blood. The result of this correlation has been to show that the regulation of hydrogen-ion concentration in the blood of man is so delicate that existing methods of measurement are far too coarse to reveal the changes in reaction to which the breathing reacts, unless where there are very great variations in the breathing. Thus with the existing methods of measurement the hydrogen-ion concentration of the blood appears to be constant; and where apparent distinct variations have been found they have nearly always been due to faulty methods of measurement. Minute variations in hydrogen-ion concentration are constantly occurring, as shown by variations in the breathing, but, as a rule, they are too small to be directly measurable by existing methods. There is also evidence that extremely small variations in hydrogen-ion concentration are of very great physiological importance.

Unfortunately, these considerations have not as yet been fully realised by medical men, or by more than a few physiologists, and the result is a veritable pandemonium of doctrine and practice in connection with real or supposed acidosis and its treatment. Dr. Sellards's book is not free from the prevailing confusion, as he seriously misinterprets the connection between breathing and the hydrogen-ion concentration of the blood. His book is, nevertheless, valuable and very well written. He rightly lays stress on the fact that, except in the extremest cases, accurate measurements show no variations in the hydrogen-ion concentration of the blood. But he proceeds to conclude that no variations exist even in what

©1919 Nature Publishing Group